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(54) Abstract Title
Electrical connector for railway carriage

(57) An electrical connector has a plurality of contacts mounted on a support 14. The support can be orientated at a number of different angles relative to a housing 12 which also has alignment means, so a range of differently polarised connectors can be made from the same components. The contacts can be mounted using a clip (160, Fig 5) with spring catches (164, 166) and/or hooks (172, 174), and can be removed using a suitable tool (200, Fig 7). The connector may have an aperture and a stop pin (210, Fig 8a) which is more robust than the contacts to prevent misalignment. The connector may have a screw case with a ratchet to prevent loosening by vibration.

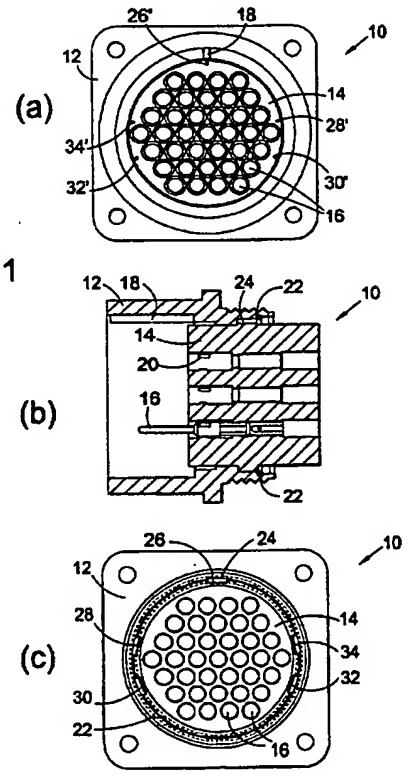

Fig.1

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

ELECTRICAL CONNECTOR

This invention generally relates to electrical connectors. More particularly it is concerned with the alignment of electrical connectors, connector pins and methods for their retention and the secure fastening of electrical connector parts. Aspects of the invention have applications for rugged, heavy-duty connectors such as are used for coupling power to railway carriages.

It is known to provide multipin electrical connectors with a key and slot arrangement to ensure correct alignment of mating male and female parts. In many applications several such connectors are to be found adjacent one another on a connection panel. It is desirable in such situations to minimize the risk of connectors being accidentally interchanged and, for example, a plug being connected to the wrong socket. The consequences of this can be serious, particularly if the connectors are carrying a large voltage or current.

To reduce the risk of this happening it is known to arrange the pins of a multipin connector so that a plug and socket with the same number of pins can only be interconnected if the pins are also in the correct relative positions. This is typically achieved by providing sets of plugs and sockets in which the pins have different rotations with respect to an orienting keyway so that only a plug and socket with the same degree of rotation of the set of pins can be mated. However, a disadvantage of this arrangement is that for construction and maintenance a complete set of plug and socket pairs with all the available pin orientations must be maintained in stock. This is expense and operationally cumbersome.

According to the present invention, there is therefore provided an electrical connector comprising: a plurality of electrical coupling means; a support to hold the coupling

means in a mutually spaced and mutually electrically insulated configuration; first alignment means for rotational alignment of the connector for mating with a second electrical connector; and second alignment means for selectable rotational orientation of the support relative to the first alignment means.

In this way, mating with a differently aligned second connector is inhibited by the relative alignment of the first and second alignment means. The second alignment means can also be selectably set to a rotational orientation for mating with the second electrical connector, and there is no need to hold a stock of connectors with any particular given orientation of the support.

Preferably the selectable orientation comprising at least two discrete orientations, and more preferably it comprises at least three discrete orientations. The more orientations that are provided, the greater the number of plugs/sockets with the same number of pins that can be used without the risk of incorrect connection.

Preferably the connector has a housing mounting the first alignment means and mating with the second connector is inhibited by misalignment of the electrical coupling means, or contact pins, relative to the second connector. In effect, for a plug and socket to be mated there are two elements to be aligned - the first alignment means, typically a key and slot arrangement on the first and second connector housings, and the electrical coupling means, typically contact pins. If the contact pins are misaligned relative to the keyway, the connectors are prevented from mating. It can be seen that the greater the rotational symmetry of the pin pattern, the fewer the number of different, non-mating orientations. Thus, to some extent, there is a compromise between the number of pins a given connector possesses and the number of mutually non-mating plug and socket pairs which can be provided for that number of pins.

In a preferred embodiment, the support and housing are provided with inter-engaging formations for the second alignment means. Thus, the housing (or the support) can, for example, be provided with a lug which engages with one of a number of

circumferentially positioned recesses on the support (or the housing) to allow the support, and therefore the pins, to be positioned in one of a plurality of predetermined rotational positions relative to the housing.

Preferably, unlike known arrangements, the support for the contact pins is substantially non-resilient. This gives the support greater structural integrity and strength, which provides greater durability for a connector with selectable orientations of the support. It also has the added benefit of holding the contact pins more securely so that they are less likely to twist or bend.

Therefore, according to another aspect of the present invention, there is provided a substantially non-resilient, generally cylindrical support for a multipin electrical connector comprising a plurality of keying projections or recesses circumferentially disposed around a perimeter of the support for selectable rotational alignment of the support in a housing about the cylindrical axis.

A further problem which is encountered in this form of connector is that of securely retaining a contact pin within its support. According to a further aspect of the invention, there is therefore provided a substantially non-resilient support for an electrical contact of the pin and socket type, comprising an aperture to receive the contact and having a shoulder circumferentially disposed around an interior surface of the aperture for engagement by oppositely directed spring catches for securing the contact within the aperture.

Also addressing this problem, there is provided a retaining device for an electrical contact comprising a spring clip for fitting around a reduced circumference portion of the contact, the clip comprising a pair of oppositely directed spring catches for engaging a shoulder within an aperture in which the contact is to be mounted. The spring clip's resilience allows it to be readily attached to the contact and the oppositely directed spring catches securely retain the contact within its support.

Preferably the retaining device includes a second pair of oppositely directed spring catches substantially opposite the first pair. This positioning ensures that both pairs of spring catches engage and improves the retention of the contact. Typically, retaining force of 70N is sufficient for a rugged connector for carrying a current of ten amps.

There is also provided a method of retaining a electrical contact within support using a spring clip comprising a pair of oppositely directed spring catches. Preferably, the spring clip is fitted around a reduced circumference portion of the contact prior to inserting the contact into an aperture within the support. According to the invention there is also provided a tool for extracting such a contact from its support comprising a tubular portion for insertion over the contact to urge inwards at least one spring catch of the clip, to free the clip from within the support so that it can be pushed out of the support by longitudinal movement of a plunger within the bore of the tube.

According to a still further aspect of the invention, there is provided a retaining device a spring clip retaining device for fastening about a cylindrical portion of an electrical contact, the spring clip having a generally tubular shape, open down one side for mounting the clip on the contact, the edges of the clip adjacent the opening each having a hook formation whereby the clip, when attached to the contact, is supported substantially symmetrically about the cylindrical portion by the hook formations. In this way a clip is spaced away from the contact except at the points where it is supported on the contact, and this spacing enhances the clips' resilience, and more particularly facilitates radially inwards compression of the clip, thereby assisting in securing the contact within a support. Preferably the clip is also supported at the rear (opposite the opening) by an indented spine. In a preferred arrangement the clip has spring catches positioned between points where the clip is supported on the contact, that is between the hook formations and the spine.

A further problem encountered with this and other electrical connectors of the multipin type is that even when the pin arrangements are not exactly aligned it is nevertheless sometimes possible to force male and female connectors together in a misaligned

orientation. This is a particular problem when there is a large number of pins as the pins tend to be narrow and easily bent and the lands between sockets on the female connector tend to be small.

According to a further aspect of the invention there is therefore provided a method of inhibiting misaligned mating between two mating electrical connectors, a first connector having a plurality of male electrical connecting elements, a second connector having a corresponding plurality of mating female electrical connecting elements, each element being mounted in a respective aperture, the method comprising: omitting a pair of mating male and female connecting elements; and providing in one of the vacant apertures a means to ensure alignment with the corresponding aperture on the other connector, before the male and female connecting elements can mesh.

In a still further aspect the invention provides an electrical connector system comprising two mating electrical connectors, a first connector having a plurality of male electrical connecting elements, a second connector having a corresponding plurality of mating female electrical connecting elements each mounted in a respective socket, and wherein one of the first and second connectors has an additional aperture suitable for mounting a said male or female connecting element, and wherein the other connector has stop means, extending from the connector, to inhibit misaligned mating between the two connectors, the stop means being sized to fit within said additional aperture.

The applicant has realised that frequently some connecting elements of a multipin connector are spare and that one or more of these may be replaced by a pin to act as a stop to prevent misaligned mating of the connectors. The pin takes the place of a male or female connecting element and inserts into a position where a corresponding female or male connector element would otherwise be located in the mating connector. Preferably the stop is larger than a connector pin, for increased robustness, but the stop must be small enough to fit into either an unmodified female connector (if the stop is long and narrow) or the socket left once a connecting element has been removed. Preferably the stop is longer than the protruding part of a male connecting element to

prevent misaligned electrical connections. Where the connectors are physically coupled by means of a screw thread or other arrangement, the stop is preferably long enough to prevent any physical purchase by the thread or other arrangement so that the connectors can not be levered together.

According to a further aspect of the present invention, there is provided a multipin electrical connector system for reduced vibration susceptibility comprising mating male and female connectors each having a plurality of mutually interconnecting electrical contacts mounted within male and female housing portions, the housing portions being configured for series-thread fastening to one another, by rotation of one housing portion relative to the other, one of the male and female portions being provided with a ratchet mechanism requiring sufficient force to undo the fastening to confer a degree of vibrational immunity but permitting unfastening of the connectors without damage to the ratchet mechanism.

These and other aspects of the present invention will now be further described, by way of example only, with reference to the accompanying figures in which:

Figures 1(a) to (c) show, respectively, face, longitudinal cross-section, and rear views of a multipin male connector according to an embodiment of an aspect of the present invention;

Figures 2(a) and (b) show, respectively, a face view and a longitudinal cross-section view of a multipin female electrical connector;

Figures 3(a) to 3(f) show stages in changing a relative orientation of a contact pin support;

Figure 4 shows examples of pin configurations for a multiple connector (either contact configurations can be used);

Figure 5 shows male (A and B) and female (C and D) contact pins inside and transverse cross-sectional view, the contact pins mounting a clip embodying aspects of the present invention;

Figure 6 shows insertion of male (A and B) and female (C and D) contacts into a support;

Figure 7 shows stages in the removal of contact pins from a support; and

Figures 8(a) to 8(e) show electrical connectors incorporating a stop to prevent misaligned mating.

Referring first to Figure 1, a male multipin connector is generally illustrated at 10. The connector has a housing 12, as illustrated with a face plate for panel mounting. Within the housing a support 14 mounts a plurality of contact pins 16. The connector housing has a keying formation 18 which engages with a corresponding recess on the housing of a female connector with which it mates to bring pins 16 into proper relative alignment with corresponding sockets on the female connector. Various fittings may be attached to the rear of the connector according to the application.

The support in which pins 16 are mounted is one piece formed from hard plastic, such as polyphenylene sulphide, although other suitable materials, such as ceramic, can also be used. The support is detachably fastened within housing 12 using a circlip 22. A plurality of notches 26, 28, 30, 32 and 34, are provided around the periphery of the support at the rear. When the support is mounted within housing 12 one of these notches engages a lug 24 on the housing to hold the support in a predetermined rotational orientation relative to keying formation 18. As illustrated, notch 26 engages lug 24. The relative alignment of the support, and therefore of the pattern pins, with respect to the keying formation in the housing can be altered by removing the support from its housing, turning it so that a different one of the notches engages lug 24 and then refastening the support within the housing using the circlip.

The number of notches is determined by the number of different desired orientations and to some extent, as explained above, is constrained by the number and pattern of pins in the connector. In the illustrated embodiment the support has five predetermined selectable orientations. Preferably, for ease of identifying which orientation is selected, the positions of the notches are indicated on the front face of the support as shown at 26', 28', 30', 32' and 34'.

Referring now to Figure 2, this shows a female connector 40 suitable for mating with the male connector of Figure 1. Like the connector of Figure 1, female connector 40 has a housing 42 mounting a support 44 for a plurality of socket pins 46. The housing 42 has an alignment slot 48 to receive keying formation 18 of the male connector. The rear of the connector 40 is provided with a rubber grommet 50 and a plastic follower 52. Like the male connector, support 44 is removably held in place within the housing by a circlip 54. Like the male connector, support 44 has a plurality of notches around its periphery at the rear to engage with an orientation lug 56 cast into the housing. The positions of the notches are indicated at 58, 60, 62, 64 and 66 on the mating face of the support.

Referring again to Figure 1, with the support in the orientation shown, with lug 24 in notch 26, the male connector 10 will only mate with the female connector 40 when lug 56 engages notch 58 of the female connector support. Only when the supports are in these positions do pins 16 properly line up with sockets 46 when keying formation 18 aligns with slot 48. If, for example, lug 48 were engaged with a notch at position 60 when the keying formation and slot of the respective housings were aligned, the pins would be out of alignment and the connectors would therefore not mate. Preferably the notch positions are chosen to provide a unique orientation of the pattern of pins with respect to the alignment means on the connector housing. Such a choice makes it possible to provide up to five mated pairs of connectors with the same number of pins whilst at the same time ensuring that it is difficult or impossible to mate together the wrong pairs of connectors.

Referring now to Figure 3, this illustrates the steps in a method of changing the orientation of the support. A connector is generally illustrated at 70 and comprises a housing 72 for a support 74 for a plurality of electrical contacts 76. The support is fastened within the housing by circlip 78 and has a notch 82 engaging with lug 80 on the housing. Figures 3(a) and (b) show, respectively, a longitudinal cross-section through the connector and a rear view of the connector. Although the connector is illustrated with contacts 76 loaded into the support, the orientation of the support can be changed before or after the contacts are loaded.

Referring to Figure 3(a), circlip 78 is first removed, and then support 74 is withdrawn from housing 72 (Figure 3(d)). The support can then be rotated. After the support has been rotated to the desired position it is replaced within housing 72 and circlip 78 is replaced to retain the support within the housing.

In Figures 3(e) and (f), which show, respectively, front and rear views of the connector, the support has been rotated 110° anticlockwise when viewing from the rear. The effect of this has been to bring notch 84 (shown in Figure 3(b)) into engagement with lug 80, thus rotating the pattern of pins with respect to keying formation 86 in housing 72. As illustrated in Figures 3(e) and (f), connector 70 cannot be mated with a connector with a contact arrangement as shown in Figures 1(a) and 2(a), despite the contacts having the same number of pins. It can therefore be seen that providing a removable support 74 provides a cheap and flexible way of making available a range of uniquely mating pairs of connectors without the need to supply or stock matched pairs of connectors. Preferably, for durability, the support mounting the electrical contacts is hard and substantially non-resilient.

Referring now to Figure 4, this shows pin patterns and sets of notch positions for providing sets of connectors with distinguishable pin pattern orientations. The pin patterns illustrated are all symmetrical about a vertical axis and a single "normal position" notch is provided on this axis. The remaining notches are shown

symmetrically disposed on either side of the axis of symmetry but, if desired, notches can be provided on only one side of this axis. It will also be understood that the number of notches provided can be varied.

Figure 4(a) shows a pattern 90 of 10 contacts with a "normal position" notch at 91 and with further notches 92 and 93. Figure 4(b) shows a pattern 95 of 19 contacts with a normal position notch 96 and further notches 97 and 98. Figure 4(c) shows a pattern 100 of 25 contacts with a normal position notch at 101 and further notches 102, 103, 104 and 105. Figure 4(d) shows a pattern 110 of 37 contacts with a normal position notch at 111 and further notches 112, 113, 114 and 115 at 80, 110, 250 and 280° respectively from notch 111. Figure 4(e) shows a pattern 120 of 13 contacts with a normal position notch 121 and further notches 122, 123, 124 and 125. Figure 4(f) shows a pattern 130 of 22 contacts with a normal position notch 131 and further notches 132, 133, 134 and 135. Figure 4(g) shows a pattern 140 of 35 contacts with a normal position notch 141 and further notches 142, 143, 144 and 145. Figure 4(h) shows a pattern 150 of 60 contacts with a normal notch 151 and further notches 152, 153, 154 and 155. Figure 4J shows yet another arrangement.

The contact arrangements shown are only examples of those available.

Referring to Figure 5, this shows in more detail male 16 and female 46 contact pins for use with the male and female connectors of Figures 1 and 2 respectively. An end 16a of the male contact is configured to engage with a socket end 46a of the female contact. The other ends 16b, 46b of the contacts are adapted to receive an electrical cable (not shown). Figures 5(a) and (c) show male and female contacts of a first size and Figure 5(b) and (d) show male and female contacts of a second, larger size. The contacts 16, 46 are inserted into the support from its rear and urged towards the mating face of the support. Spring clips 160, preferably made from beryllium copper, retain the contacts within the support as shown in Figures 1 and 2.

Figure 5 also shows transverse cross-sections through the contacts along the lines I-I. These show the form of clip 160 in more detail. Referring particularly to Figure 5(d), it can be seen that spring clip 160 has a generally tubular shape open down one side 162 for attaching the clip around a reduced circumference portion 47 of contact 46. The clip has a first pair of oppositely directed spring catches 164, 166 and a corresponding pair of catches 168, 170 substantially oppositely disposed through the first pair of catches about the contact. Catches 164, 166, 168 and 170 can be readily formed by bending arms up away from the surface of the clip.

In a preferred embodiment the clip is given additional resilience by supporting it so that the surface of the clip is out of contact with the reduced circumference portion of the contact. This can be achieved by bending the edges of the clip defining the open side inwards as shown in transverse section at 172 and 174 to create a form of hook. These edges provide two lines of contact for supporting the clip. Preferably the surface of the clip generally opposite opening 162 is also deformed inwards as shown at 176 to bear upon the contact, either at a point or along a line. For simplicity of manufacture and to better control alignment, the clip is preferably deformed to create an indented spine opposite opening 162.

Figure 6 shows a method of insertion of male and female contacts (illustratively of two different sizes) into contact supports generically indicated at 180. First a cable 182 is attached to a contact 16, 46 and a spring clip 160 is fitted onto the contact. The contact is then inserted into support 180 and pushed home so that catches 164, 166, 168 and 170 engage with the edges of a shoulder 184 provided on the interior surface of an aperture 186 in a support receiving the connector. The oppositely directed pairs of catches hold the contacts in position longitudinally within apertures 186 and reduce the risk of wrong positioning of contacts during assembly. Preferably support 180 is formed from a hard material so that the catches 164 to 170 of a spring clip 160 engage positively with the support.

Each aperture 186 has three pips 20 formed on the wall surface to align and support the mating ends 16a, 46a of the pin and socket contacts.

Figure 7 shows the use of an extraction tool 200 for removing a contact bearing a clip 160 (as illustrated, a female contact pin 46) from its support 180. Extraction tool 200 comprises a tubular sheath 190 which fits around contact pin 46, between the contact pin and support 180 (the small circumferential gap 187 into which this tubular sheath fits is shown in Figure 6(d)). The tubular sheath fits over catches 164 and 168 and depresses them so that they lie flush with the surface of clip 160. A plunger 192 with a handle 194 is then inserted into sheath 190 so that one end 192a of the plunger abuts against one end 46a of the contact to be removed (Figure 7(a)). The plunger 192 is then pushed against contact 46 which is free to move, with its clip 160, past shoulder 184 within the support and out of the rear of the support, as shown in Figure 7(b).

Figure 8 shows how a stop can be used to inhibit misaligned mating of connectors. Referring to Figure 8(a), this shows male 10 and female 40 multipin connectors generally similar to those in the previous figures. Male connecting pins 16 are mounted in apertures 186 of support 14 and female sockets 46 are mounted in similar apertures in support 44. One of pins 16 has been replaced by a more robust stop pin 210, sized to fit aperture 186. Stop pin 210 has a greater diameter than electrical connection pin 16, making it more robust, and is also longer than pin 16, to prevent mismated electrical connections. A single stop pin 210 can be employed but it is preferable, as illustrated, to use more than one stop.

As illustrated in Figure 8(a) the connectors are in a misaligned orientation. Figure 8(b) shows the same connectors when aligned for mating. It can be seen that, in this orientation, stop pin 210 is aligned for insertion into aperture 186 whilst electrical connection pin 16 is correctly aligned for mating with its corresponding socket 46. Figure 8(c) shows the mated connectors with stop pin 210 inserted into aperture 186. The socket 46 which would have occupied the aperture filled by the stop has been removed.

Figure 8(d) shows stop pins 210 abutting against support 44, on the lands 212 between apertures 186, preventing misaligned mating.

The pins 210 are preferably sufficiently long to prevent the bayonet coupling or screw coupling from starting to mesh. In this way, extra force can be applied by the user, via the coupling, to force the parts together.

Figure 8(e) illustrates one of the problems encountered when stop pins 210 are not included. In this case electrical connector pin 16 abuts directly on land 212 of support 44 and may be bent or otherwise damaged.

When used in environmentally demanding applications, particularly when the connector is subject to vibration, for example when coupling power between railway carriages, mating connectors preferably include vibration resistant means to physically couple the housings of male and female connectors. It has been found that this can be achieved whilst still permitting manual disconnection and reconnection by providing male and female housings which screw together with a ratchet mechanism. In one embodiment housing 12 of a male connector is provided with a three-start square thread and a correspondingly threaded retainer ring is provided for the mating female connector. A plurality of generally triangular teeth are provided around an inner circumference of the retaining ring and a resilient bias means mounted on a part of the housing against which the retaining rotates, is used to bias a ball or metal leaf into a space between the teeth. The force exerted by the resilient bias means is chosen such that the male and female connectors can be screwed together manually (or, for great vibration resistance) using an appropriate tool) whilst conferring a desired degree of resistance to the connection being loosened by vibration.

Advantageously the above described connectors can be formed from plastic to reduce manufacturing costs. It is then desirable that support 14 and 44 are formed from hard, non-moisture absorbent plastic such as polyphenylene sulphide, whilst the housing can

be formed from a less hard, less moisture resistant plastic material. A positive feel to connection of the male and female connectors can be provided in which one housing screws onto another, the screw thread ending at a point when the connectors are fully mutually engaged. By forming the end of the thread so that the connectors slightly release from one another at the fully engaged position. This can be achieved by molding the threads so that its end turns slightly towards where it begins on the rim of the housing. This positive feel can be enhanced by including means for some resilience between the mating connectors.

No doubt other effective variations and modifications to these arrangements will occur to the skilled person and the invention is not limited to the described embodiments.

CLAIMS:

1. An electrical connector comprising:

a plurality of electrical coupling means;

a support to hold the coupling means in a mutually spaced and mutually electrically insulated configuration;

first alignment means for rotational alignment of the connector for mating with a second electrical connector; and

second alignment means for selectable rotational orientation of the support relative to the first alignment means.

2. An electrical connector as claimed in claim 1, wherein the selectable orientation comprises at least two discrete orientations.

3. An electrical connector as claimed in claim 2, wherein the selectable orientation comprises three discrete orientations.

4. An electrical connector as claimed in any one of claims 1 to 3, further comprising a housing mounting the first alignment means and wherein mating with the second connector is inhibited by misalignment of the electrical coupling means relative to the second connector.

5. An electrical connector as claimed in claim 4 further comprising stop means extending from the connector to inhibit misaligned mating with the second connector.

6. An electrical connector as claimed in claim 5 wherein each electrical coupling means comprises either a female or male coupling means to mate with a corresponding female or male coupling means of the second connector and wherein the stop means is at least as long as a length of a portion of a said male coupling means extending from the connector supporting it.

7. An electrical connector as claimed in claim 6 wherein a said female coupling means is mounted in an aperture and wherein the stop means is sized to fit within or substantially match a dimension of the aperture.

8. An electrical connector as claimed in any one of claims 4 to 7, wherein the second alignment means comprises a first formation on one of the support and the housing, to inter-engage with a selected one of a plurality of second formations on the other of the support and the housing.

9. An electrical connector as claimed in any preceding claim, wherein the support is substantially non-resilient.

10. A electrical connector as claimed in any preceding claim wherein the support is mounted in a housing and wherein the support and housing are both formed from plastic.

11. A substantially non-resilient, generally cylindrical support for a multipin electrical connector comprising a plurality of keying projections or recesses circumferentially disposed around a perimeter of the support for selectable rotational alignment of the support in a housing about the cylindrical axis.

12. A substantially non-resilient support for an electrical contact of the pin and socket type, comprising an aperture to receive the contact and having a shoulder circumferentially disposed around an interior surface of the aperture for engagement by oppositely directed spring catches for securing the contact within the aperture.

13. A retaining device for an electrical contact comprising a spring clip for fitting around a reduced circumference portion of the contact, the clip comprising a pair of oppositely directed spring catches for engaging a shoulder within an aperture in which the contact is to be mounted.

14. A retaining device as claimed in claim 13, further comprising a second pair of oppositely directed spring catches, substantially diametrically opposite the first pair.

15. A retaining device as claimed in claims 13 or 14, configured for three point contact with the reduced circumference portion, whereby the spring clip is supported in a substantially symmetrical position about a longitudinal axis of the contact.

16. A spring clip retaining device for fastening about a cylindrical portion of an electrical contact, the spring clip having a generally tubular shape, open down one side for mounting the clip on the contact, the edges of the clip adjacent the opening each having a hook formation whereby the clip, when attached to the contact, is supported substantially symmetrically about the cylindrical portion by the hook formations.

17. A spring clip retaining device as claimed in claim 16, wherein the back of the clip substantially opposite the opening is shaped to form an indented spine.

18. An electrical connector system comprising two mating electrical connectors, a first connector having a plurality of male electrical connecting elements, a second connector having a corresponding plurality of mating female electrical connecting elements each mounted in a respective aperture, and wherein one of the first and second connectors has an additional aperture, and the other connector has stop means, extending from the connector, to inhibit misaligned mating between the two connectors, the stop means being sized to fit within said additional aperture.

19. An electrical connector system as claimed in claim 18 wherein a circumference of said stop means is greater than a circumference of a said male connecting element.

20. An electrical connector system as claimed in claim 18 or 19 wherein the stop means is sized to substantially match said additional aperture.

21. An electrical connector system as claimed in claims 18, 19 or 20 wherein the stop means is as long as or longer than a length of a portion of a male connecting element extending from its connector.

22. An electrical connector system as claimed in any one of claims 18 to 21 wherein said stop means is mounted in the first connector in place of a said male connecting element.

23. An electrical connector system as claimed in any one of claims 18 to 22 wherein each connector comprises a support to hold the connecting elements, first alignment means for relative rotational alignment of the connectors, and second alignment means for rotational orientation of the support relative to the first alignment means.

24. An electrical connector for the electrical connector system of any one of claims 18 to 23.

25. A method of inhibiting misaligned mating between two mating electrical connectors, a first connector having a plurality of apertures, some of which are filled with male electrical connecting elements, a second connector having a corresponding plurality apertures some of which are filled with mating female electrical connecting elements, the method comprising: providing in an unfilled socket on one of the connectors a stop means sized to fit within the corresponding aperture on the other connector.

26. A method as claimed in claim 25 wherein the stop means is provided on the connector carrying the male connecting elements.

27. A method as claimed in claim 25 or 26 wherein the stop means is as long as or longer than a length of an electrical contact portion of a male connecting element.

28. A multipin electrical connector system for reduced vibration susceptibility comprising mating male and female connectors each having a plurality of mutually interconnecting electrical contacts mounted within male and female housing portions, the housing portions being configured for series-thread fastening to one another, by rotation of one housing portion relative to the other, one of the male and female portions being provided with a ratchet mechanism requiring sufficient force to undo the fastening to confer a degree of vibrational immunity but permitting unfastening of the connectors without damage to the ratchet mechanism.

29. An electrical connector substantially as hereinbefore described with reference to Figures 1 to 3, and/or Figure 8.

30. A support for electrical contacts for a mulicontact electrical connector substantially as hereinbefore described with reference to any one of Figures 4A to 4H.

31. A clip for mounting a contact within a support substantially as hereinbefore described with reference to Figure 5.

32. A contact extraction tool substantially has hereinbefore described with reference to Figure 7.

INVESTOR IN PEOPLE

Application No: GB 0008127.3 Examiner: Paul Nicholls
Claims searched: 1 - 11, 30 Date of search: 14 September 2000

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.R): H2E (ECEE, ECEX)

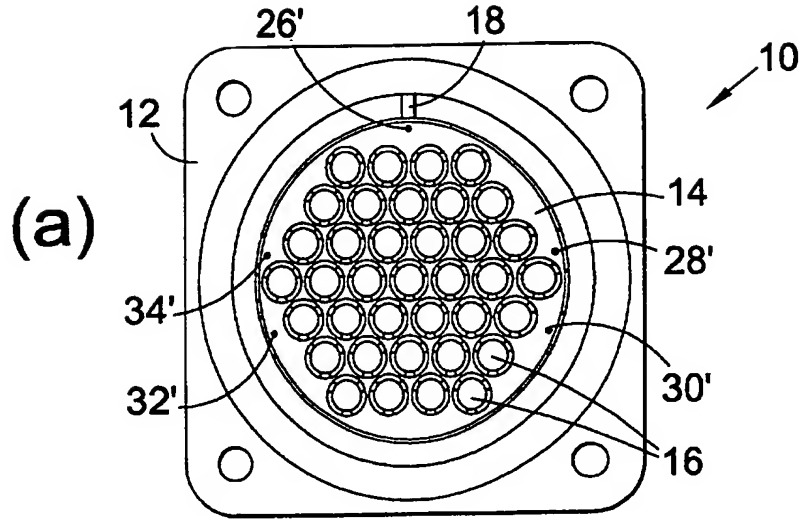
Int Cl (Ed.7): H01R 13/642, 13/645

Other:

Documents considered to be relevant:

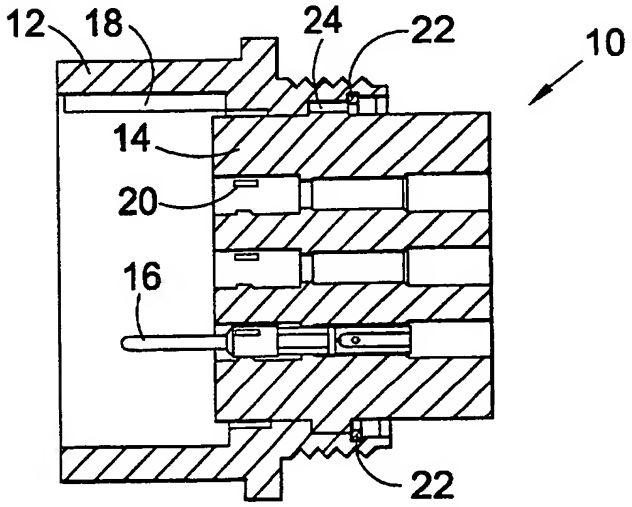
Category	Identity of document and relevant passage		Relevant to claims
X	GB 2,224,890 A	(THYSSEN) - Casing section 3 can be rotated relative to contact support 2	1-4, 8-11
X	US 4,938,718 A	(GUENDEL) - See column 3 lines 43-49	1-4, 8-11
X	US 4,229,064 A	(VETTER and HANLON) - See column 5 line 60 - column 7 line 9	1-4, 8-11

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

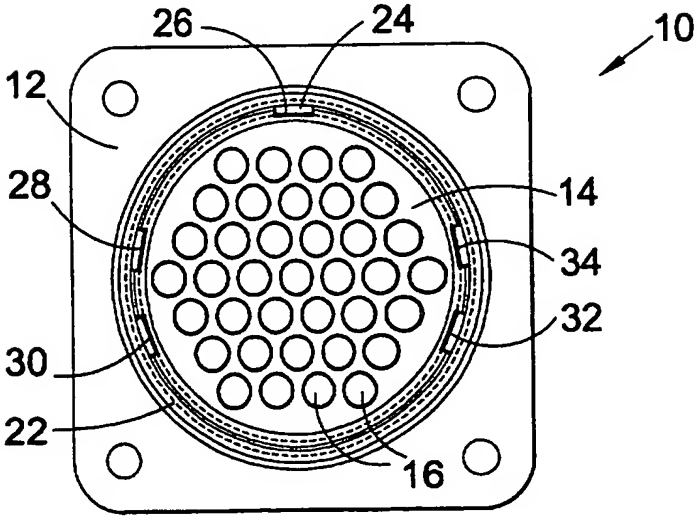

26'
18
10
12
14
28'
34'
30'
32'
16

(a)

Fig.1


12
18
24
22
10
14
20
16
22

(b)


26
24
10
12
28
14
34
32
30
22
16

(c)

(a)

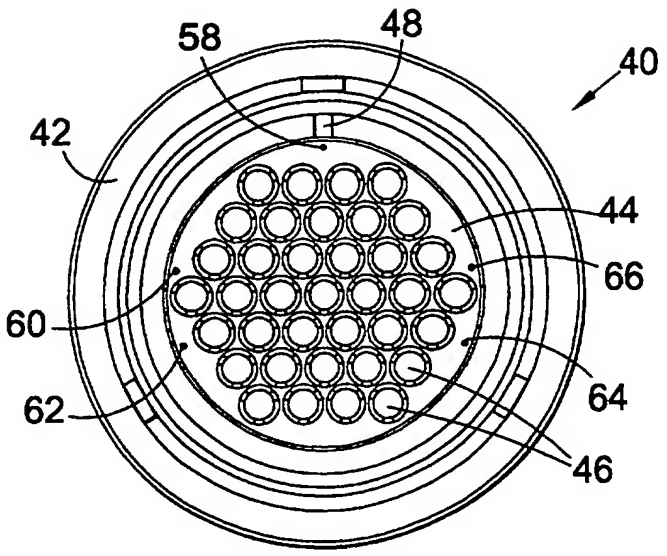
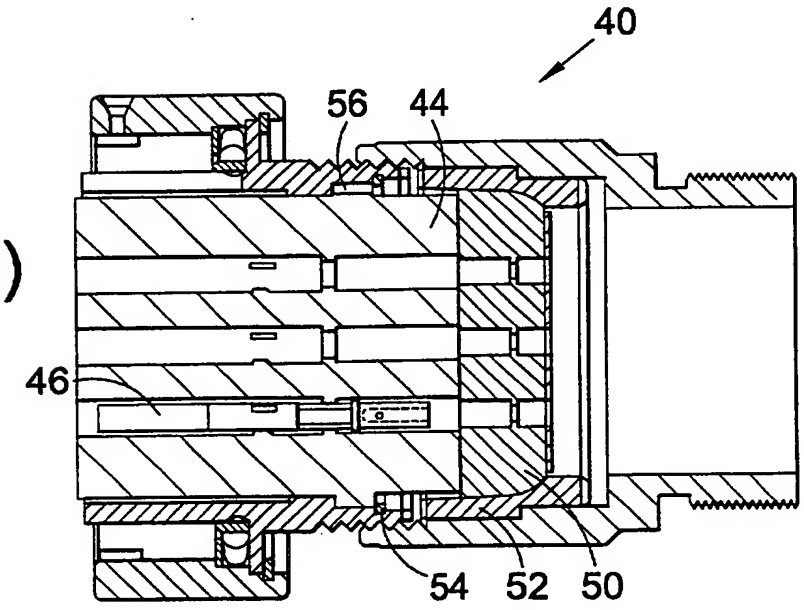


Fig.2

(b)



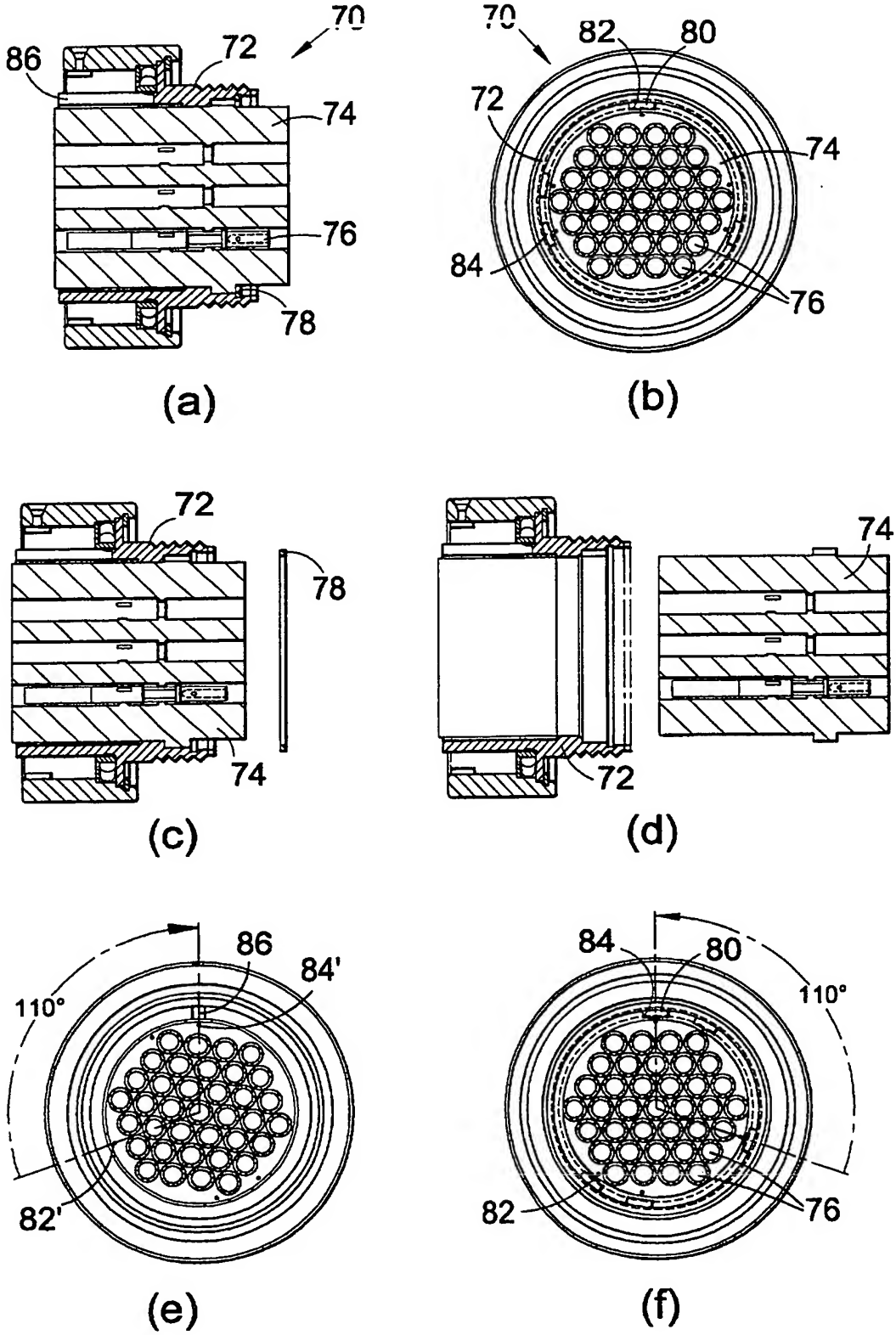

70
86
72
74
76
78
(a)
70
82
80
72
74
84
76
(b)
72
78
74
(c)
74
72
(d)
86
84'
110°
82'
(e)
84
80
110°
82
76
(f)

Fig.3

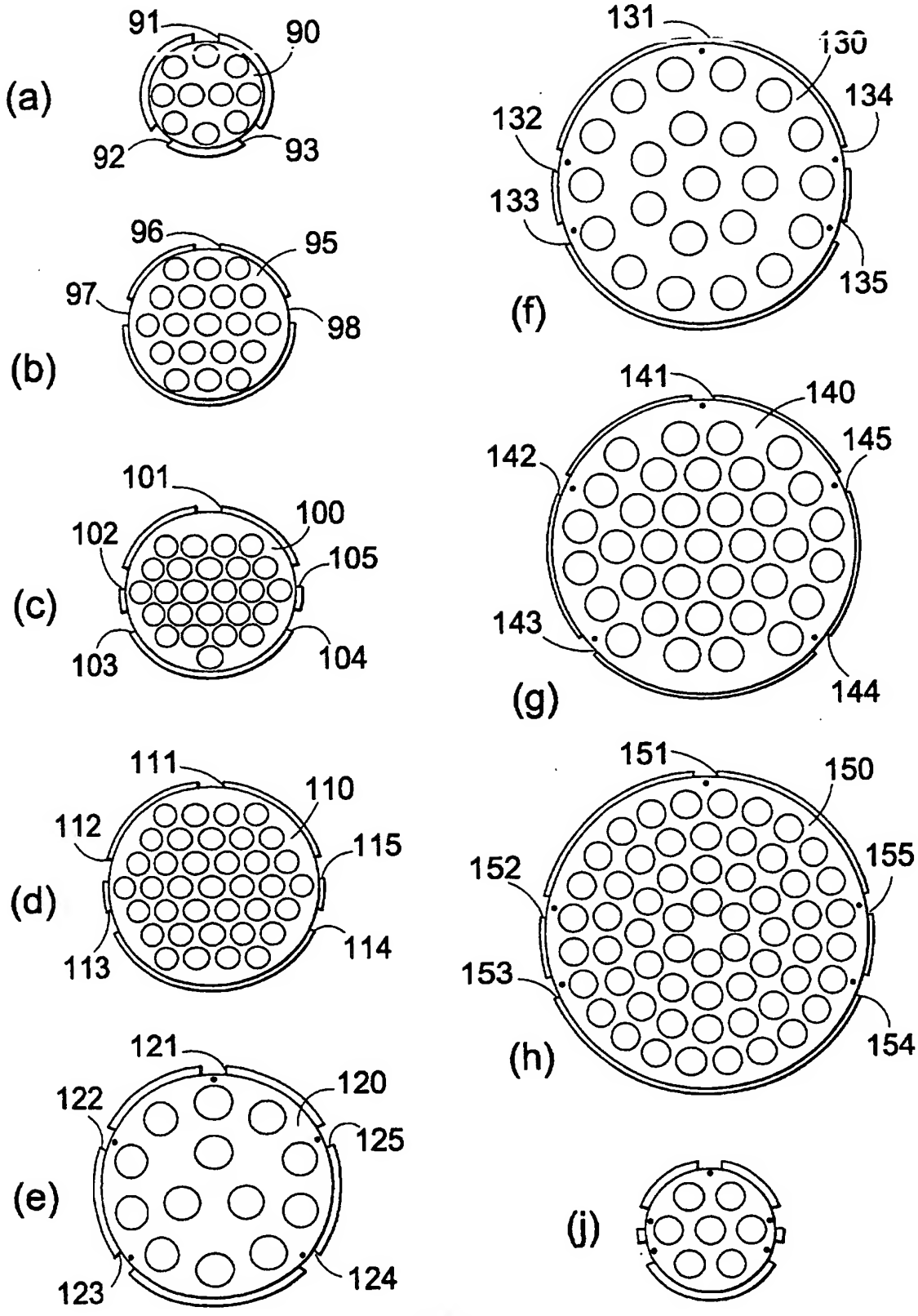

(a)
91
90
92
93
(b)
96
95
97
98
(c)
101
100
102
105
103
104
(d)
111
110
112
115
113
114
(e)
121
120
122
125
123
124
(f)
131
130
132
134
133
135
(g)
141
140
142
145
143
144
(h)
151
150
152
155
153
154
(j)

Fig.4

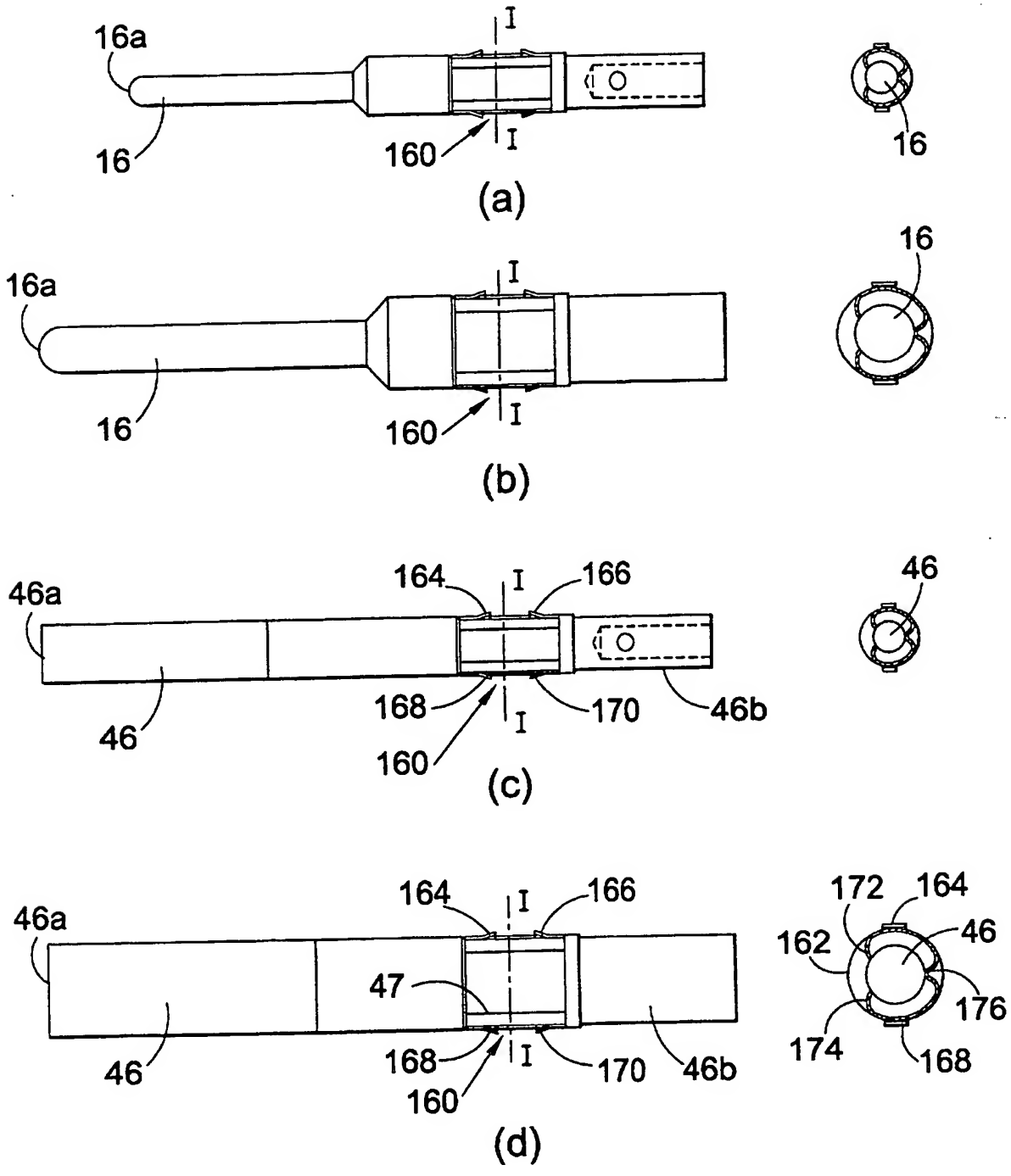

16a
16
160
I
I
16
(a)
16a
16
160
I
I
16
(b)
46a
46
164
166
168
170
160
I
46b
46
(c)
46a
46
164
166
47
168
170
160
I
46b
172
164
162
46
176
174
168
(d)

Fig.5

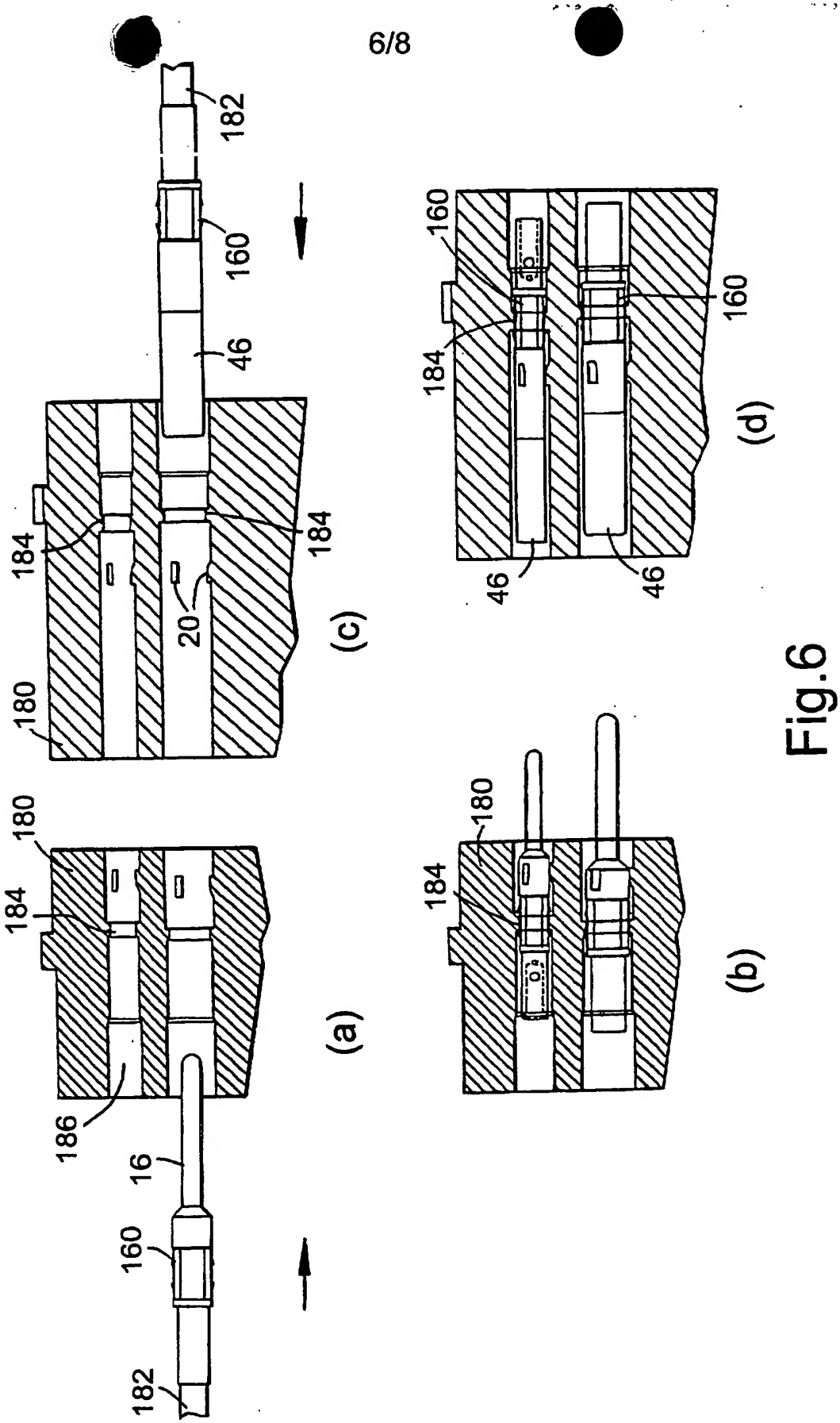

182
160
46
184
184
20
180
(c)
160
184
160
46
46
(d)
180
184
(b)
180
184
186
16
160
182
(a)

Fig.6

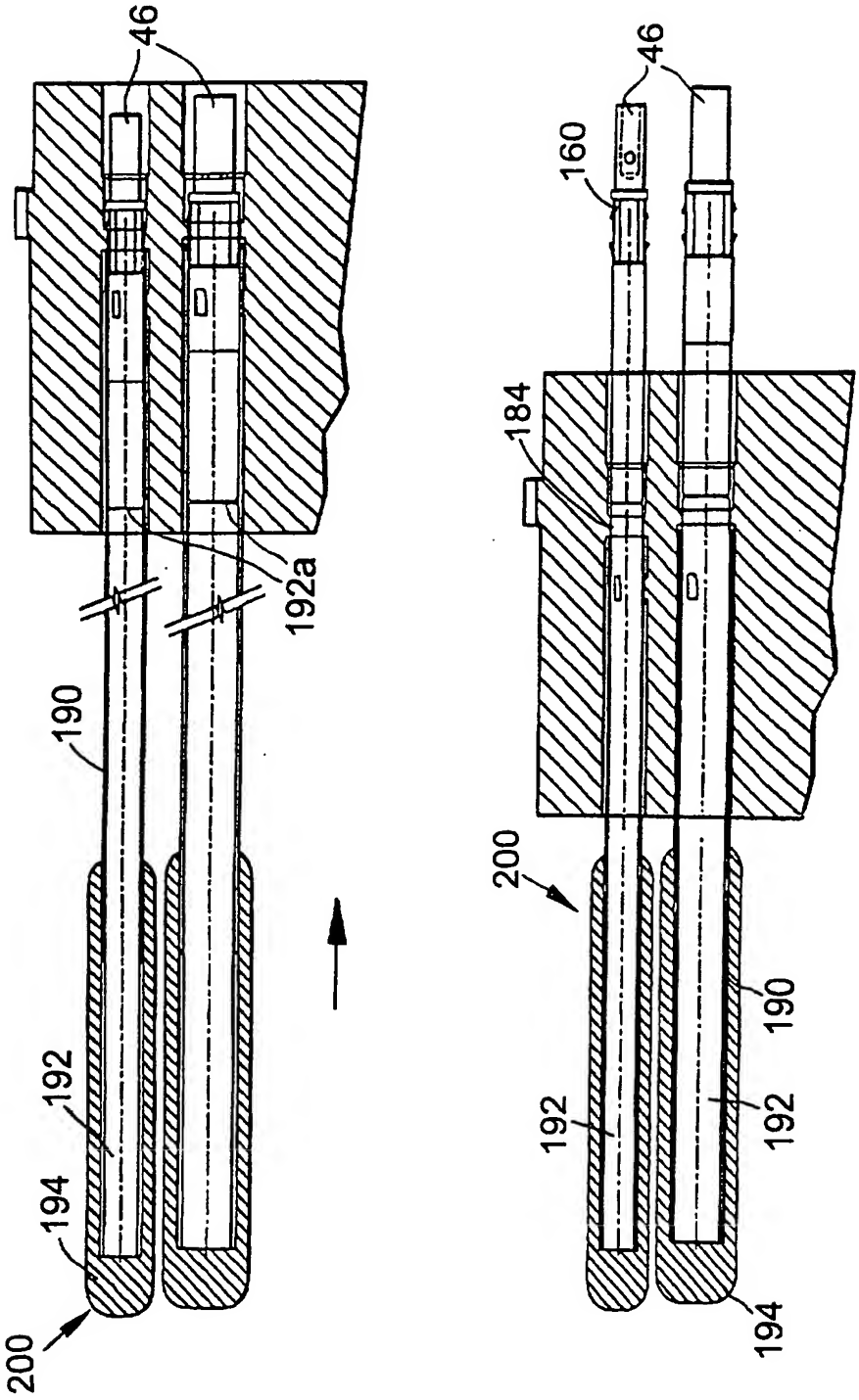


Fig.7

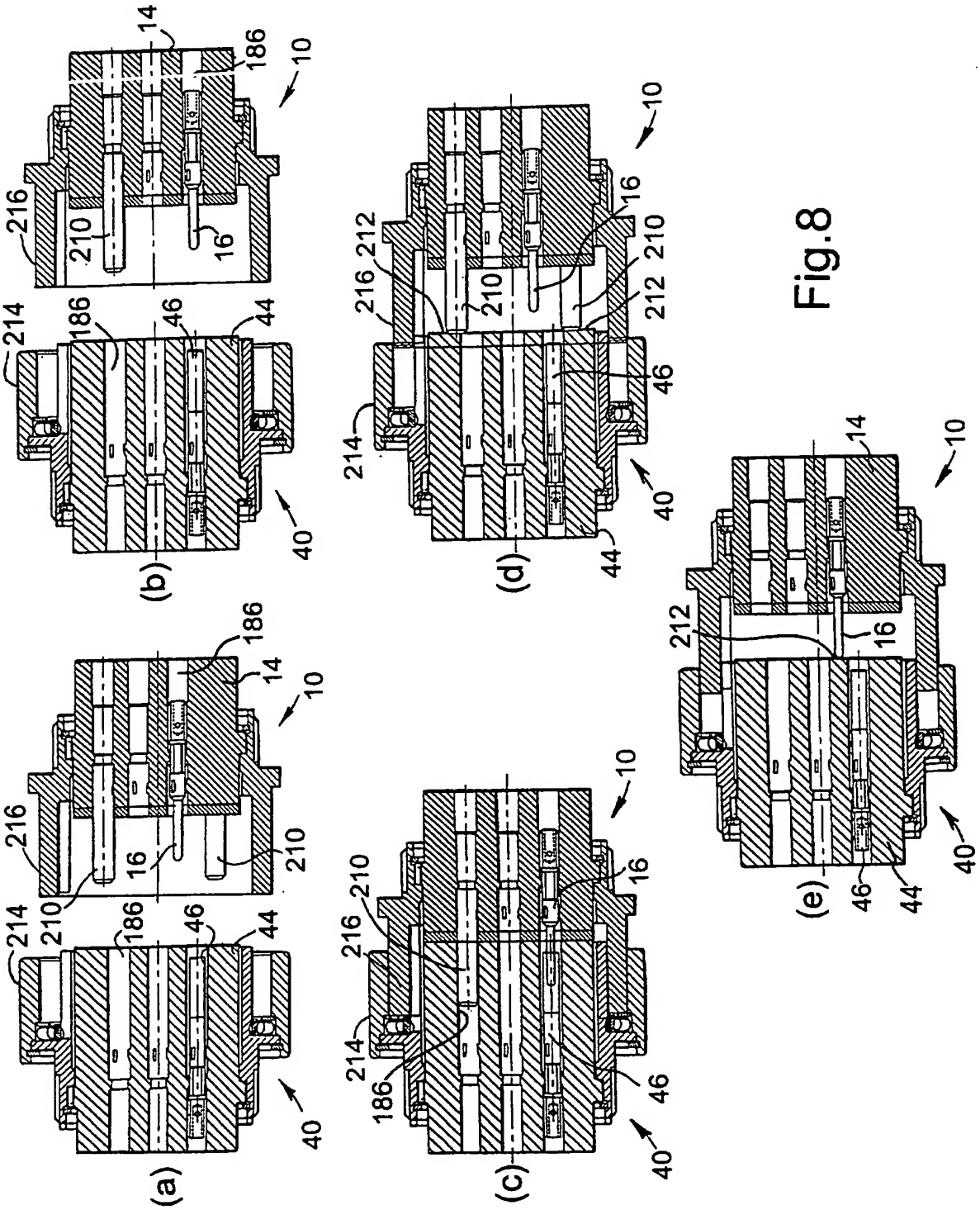


Fig.8